Performance of HP ProLiant BL465c G7 with AMD Opteron 6100 Series processors in 32- and 64-bit HP SBC environments

Technical white paper

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Executive summary

Designed for virtualization yet flexible enough for any business application, the HP ProLiant BL465c G7 server blade combines best-in-class features to help reduce network sprawl and lower infrastructure costs.

Multi-core AMD Opteron™ 6100 Series processors with up to 16 DIMMs provide the performance needed for demanding applications and virtualization workloads. The HP ProLiant BL465c G7 server blade also offers two 10 Gb Ethernet ports with converged network support, two hot plug drive bays to extend local storage options, and industry-leading management that enables powerful lights-out administration.

HP tested the optimal scalability of two bare-metal[1] HP ProLiant BL465c G7 server blade configurations, obtaining the following results:

Configuration	AMD Opteron processor	Test environment	Supported users
2P/24C[2]	Model 6174 (2.2 GHz)	64-bit	487
		32-bit	141
2P/24C	Model 6164 HE[3] (1.7 GHz)	64-bit	445
2P/16C	Model 6136 (2.4 GHz)	64-bit	411
		32-bit	161
2P/16C	Model 6128 HE (2.0 GHz)	64-bit	380

Intended audience: This performance characterization is intended primarily for IT professionals planning HP Server Based Computing (HP SBC) solution deployments. The performance and sizing information provided herein is designed to help you estimate the number of HP ProLiant BL465c G7 server blades required for a particular environment.

Testing performed in April – May 2010 is described.

[1] Non-virtualized
[2] Signifying support for two processors (P) and a total of 12 cores (C)
[3] Where HE denotes high efficiency; this is a lower-powered processor

Introduction

Figure 1 shows the HP ProLiant BL465c G7 server blade.

Figure 1. The HP ProLiant BL465c G7 server blade, illustrating a unique drawer design that allows you to service hard drives independently

G7 technologies

Seventh-generation AMD Opteron-based HP ProLiant servers such as the BL465c G7 server blade feature the following key technologies:

- AMD Opteron 6100 Series processors
- DDR3 memory
- Embedded dual-port FlexFabric 10 Gb Ethernet converged network adapter[4]
- PCI Express 2.0
- Smart Array controller with 1 GB Flash Backed Write Cache (FBWC)

FBWC
The embedded Smart Array P410i RAID controller[5] featured in the HP ProLiant BL465c G7 server blade provides 1 GB FBWC as standard. FBWC, which does not require a battery, uses flash memory. Data retention is indefinite; by comparison, retention with Battery Backed Write Cache (BBWC) is approximately two days.

[4] Currently, FlexFabric is only available on HP ProLiant c-Class server blades.
[5] FBWC may be optional on some models. For more information on FBWC, refer to http://h18004.www1.hp.com/products/quickspecs/13201_div/13201_div.HTML.

- HP Integrated Lights-Out 3 (iLO 3)
- Serial Attached SCSI (SAS)
- Thermal logic

The following sections of this paper describe testing performed by HP to characterize the performance and scalability of an HP ProLiant BL465c G7 server blade in 32- and 64-bit HP SBC environments.

Test methodology

HP continues to upgrade existing HP ProLiant servers and introduce new servers to meet particular business needs. To help you select the appropriate server for your particular HP SBC environment, HP publishes this and other performance characterizations so that you can compare individual server performance and scalability.

This section describes how HP determined the optimal number of users supported by a 2P HP ProLiant BL465c G7 server blade featuring a range of AMD Opteron Model 6100 processors – henceforth referred to as the HP ProLiant BL465c G7 server blade – in 64- and 32-bit test harnesses.

Important:
As with any laboratory testing, the performance metrics quoted in this paper are idealized. In a production environment, these metrics may be impacted by a variety of factors.
HP recommends proof-of-concept testing in a non-production environment using the actual target application as a matter of best practice for all application deployments. Testing the actual target application in a test/staging environment identical to, but isolated from, the production environment is the most effective way to characterize system behavior.

Note:
A 64-bit HP SBC environment eliminates the kernel memory constraints that can limit server scalability in a 32-bit HP SBC environment. For more information, refer to Appendix A – Using Microsoft Windows Server 2003 x64 Editions.

This section provides more information on test tools, user profile and test scenarios.

Test tools

To facilitate the placement and management of simulated loads on an HP SBC server, HP used Terminal Services Scalability Planning Tools (TSScaling), a suite of tools developed by Microsoft® to help organizations with Microsoft Windows® Server 2003 Terminal Server capacity planning.

Table 1 describes these tools.

Table 1. Components of TSScaling

Component		Description
Automation tools	Robosrv.exe	Drives the server-side of the load simulation
	Robocli.exe	Helps drive the client-side of the load simulation
Test tools	Qidle.exe	Determines if any scripts have failed and require operator intervention
	Tbscript.exe	A script interpreter that helps drive the client-side load simulation
Help files	TBScript.doc	Terminal Server bench scripting documentation
	TSScalingSetup.doc	A scalability test environment set-up guide
	TSScalingTesting.doc	A testing guide

More information

- Roboserver (Robosrv.exe) and Roboclient (Robocli.exe): Terminal Server capacity planning
- TSScaling: Windows Server 2003 Terminal Server Capacity and Scaling

User profile

To simulate a typical workload in the HP SBC test environment, HP used a script based on the following Heavy User profile:

> Heavy Users (also known as Structured Task Workers) tend to open multiple applications simultaneously and remain active for long periods. Heavy Users often leave applications open when not in use.

Table 2 outlines the activities performed by Heavy Users, which utilized Microsoft Office 2003 products.

Table 2. Activities incorporated into the test script

Activity	Description
Access	Open a database, apply a filter, search through records, add records, and delete records.
Excel	Open, print and save a large spreadsheet.
InfoPath	Enter data[6] into a form; save the form over an existing form.
Outlook	First pass: Email a short message. Second pass: Email a reply with an attachment.
Outlook_2	Create a long reply.
PowerPoint	Create a new presentation, insert clipart, and apply animation. View the presentation after each slide is created.
PowerPoint_2	Open and view a large presentation with heavy animation and many colors and gradients.
Word	Create, save, print, and email a document.

[6] Data entry for Office InfoPath 2003 requires significant processor resources.

Test scenario

To characterize its scalability, HP tested the HP ProLiant BL465c G7 server blade in 64- and 32-bit HP SBC environments when running a workload based on the User profile described above.

Note:
As recommended by HP for most applications, the FBWC was configured with 100% write for all testing. Use the BIOS to adjust the read/write ratio.

Testing was initiated by running the particular workload with a group of 15 simulated users; start times were staggered to eliminate authentication overhead. After these sessions finished, HP added 15 more users, then repeated the testing. Further users were added until the optimal number (as described below) was reached.

Performance and scalability metrics

While the Heavy User workload was running, HP monitored a range of Windows Performance Monitor (Perfmon) counters in order to characterize the performance and scalability of the tested server. HP also used canary scripts featuring Office 2003-based activities to establish the number of users that could be supported before response times became unacceptable.

HP typically uses the Perfmon **% Processor Time** counter to establish the optimal number of users supported by an HP SBC server – by definition, the number of users active when processor utilization reaches 80%. At this time, a limited number of additional users or services can be supported; however, user response times may become unacceptable.

In a 32-bit HP SBC environment, **System Page Table Entries** (PTEs) may become exhausted[7] before processor utilization reaches 80%.

To validate metrics obtained from Perfmon, HP uses canary scripts to characterize response times for a range of discrete activities, such as the time taken to invoke an application or for a modal box to appear. By monitoring response times – a very practical metric – as more and more users log on, HP has been able to demonstrate that these times are acceptable when the optimal number of users (as determined using Perfmon counter values) is active.

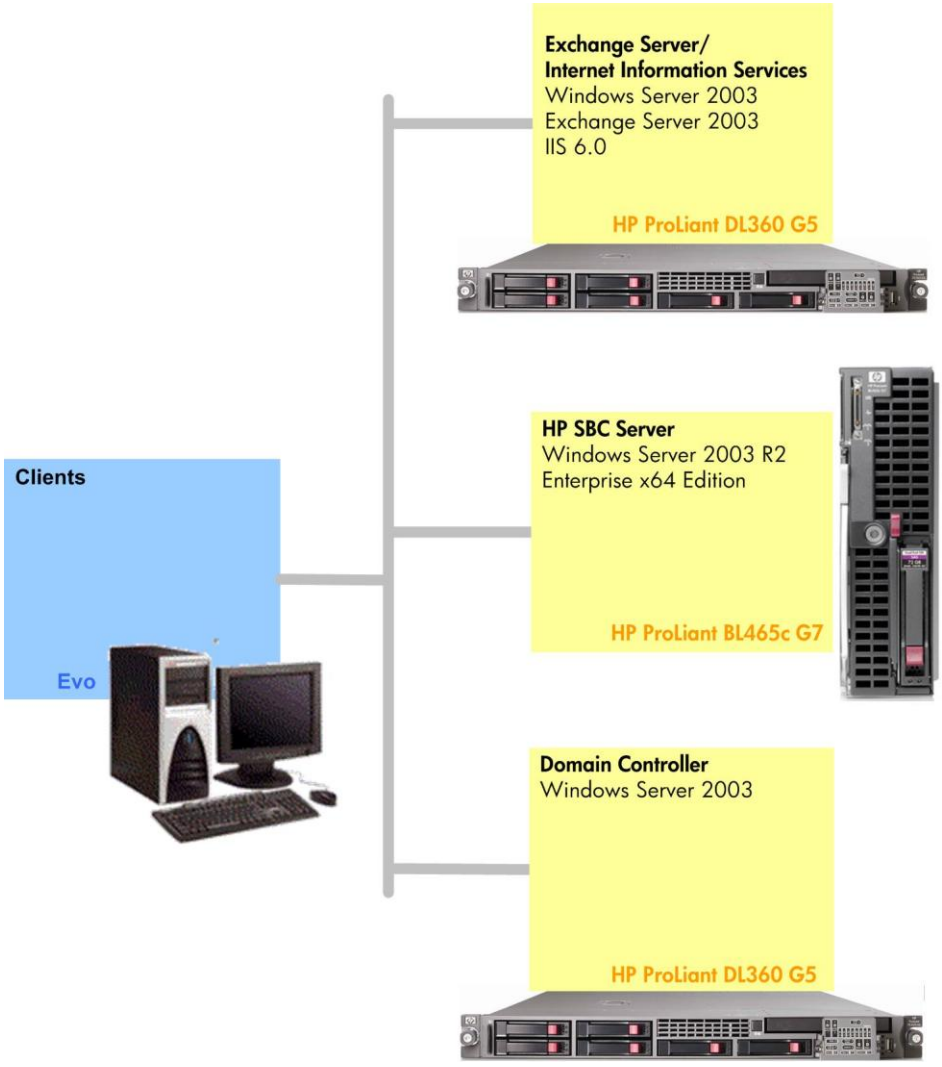
Note:
When running canary scripts, HP considers user response times to become unacceptable when they increase markedly over a baseline measurement.

[7] Due to inherent limitations in the x86 platform; for more information, refer to Appendix A – Using Microsoft Windows Server 2003 x64 Editions.

Test topology

Figure 2 illustrates the HP SBC test environment.

Figure 2. The tested environment (64-bit implementation shown)



Note:
Test environments such as that shown in Figure 2 are available to customers at HP Solution Centers to help solve a wide variety of business problems.

Configurations

This section outlines the configurations of servers and clients used in the test environment.

Table 3 presents information on system configurations; Table 4 provides a system summary.

Table 3. System configurations

Server	Configuration
HP SBC server	2P HP ProLiant BL465c G7 server blade with: • AMD Opteron processor Model 6174 (12-core/2.2 GHz), Model 6164 HE (12-core/1.7 GHz), Model 6136 (8-core/2.4 GHz), or Model 6128 HE (8-core/2.0 GHz) – 12 MB shared L3 cache • 64 GB RAM (8 GB for Model 6136, 32-bit testing) • Smart Array P410i controller with RAID 0 – Two 146 GB 10,000 rpm SAS hard drives – 96 GB page file on system partition (12 GB for Model 6136, 32-bit testing) – 1 GB FBWC (100% write) • HP NC551i Dual Port FlexFabric 10 Gb Ethernet Converged Network Adapter
	64-bit: Windows Server 2003 R2 Enterprise x64 Edition with Service Pack 2 **32-bit**: Windows Server 2003 Enterprise x86 Edition with Service Pack 1 Terminal Services enabled Office 2003
Exchange Server/ Internet Information Services	2P HP ProLiant DL360 G5 server with: • Dual-core Intel® Xeon® processor (3.2 GHz) • 2 x 2 MB L2 cache • 2 GB RAM • Four 72 GB 15,000 rpm SAS hard drives • Integrated Smart Array P400i controller with RAID 5 • NC373i Multifunction Gigabit Server Adapter
	Windows Server 2003 Enterprise Edition Microsoft Exchange Server 2003 Microsoft Internet Information Services (IIS) 6.0

Continued

Table 3. System configurations (continued)

Server	Configuration
Domain controller	2P HP ProLiant DL360 G5 server with: • Dual-core Intel Xeon processor (3.2 GHz) • 2 x 2 MB L2 cache • 2 GB RAM • Four 72 GB 15,000 rpm SAS hard drives • Integrated Smart Array P400i controller with RAID 5 • NC373i Multifunction Gigabit Server Adapter
	Windows Server 2003 Enterprise Edition
Client	Variety of Intel Pentium®-based Compaq Evo workstations (600 MHz – 2.533 GHz), each with: • At least 256 MB of memory • 1024 x 768/16-bit color depth • 100 Mbps NIC
	Windows 2000 Professional or Windows XP

Table 4. System summary for the bare-metal HP ProLiant BL465c G7 server blade (listings shown in **bold** are unique to the 32-bit test environment)

Component	Description
Operating system	Microsoft Windows Server 2003, Enterprise x64 Edition/ **Microsoft Windows Server 2003, Enterprise Edition**
Version	5.2.3790 Service Pack 2, Build 3790/ **5.2.3790 Service Pack 1, Build 3790**
Other OS description	R2/**Not applicable**
System model	ProLiant BL465 G7
System type	x64-based PC/**x86-based PC**
Processor – each of 24 cores (Model 6174 or 6164 HE) or 16 cores (Model 6136 or 6128 HE)	AMD64/**x86** Family 16 Model 9 Stepping 1 Authentic AMD Model 6174: ~2200 MHz Model 6164 HE: ~1700 MHz Model 6136: ~2400 MHz Model 6128 HE: ~2000 MHz
BIOS version/date	HP A19, 1/22/2010
SMBIOS version	2.6
Windows directory	C:\WINDOWS
System directory	C:\WINDOWS\system32

Continued

Table 4. System summary for the bare-metal HP ProLiant BL465c G7 server blade (continued)

Component	Description
Boot device	\Device\HarddiskVolume1
Locale	United States
Hardware abstraction layer	5.2.3790.3959 (srv03_sp2_rtm.070216-1710)/ **5.2.3790.1830 (srv03_sp1_rtm.050324-1447)**
User name	Not available
Total physical memory	Model 6174: 65,531.39 MB/**65,531.39 MB** Model 6164 HE: 65,531.39 MB Model 6136: 65,531.39 MB /**8,187.39 MB** Model 6128 HE: 65,531.39 MB
Available physical memory	Model 6174: 61.96 GB/**3.25 GB** Model 6164 HE: 62.06 GB Model 6136: 61.95 GB/**3.56 GB** Model 6128 HE: 62.03 GB
Total virtual memory	Model 6174: 158.42 GB/**3.25 GB** Model 6164 HE: 158.42 GB Model 6136: 158.42 GB/**3.80 GB** Model 6128 HE:158.42 GB
Available virtual memory	Model 6174: 157.98 GB/**3.25 GB** Model 6164 HE: 158.06 GB Model 6136: 157.97 GB/**3.56 GB** Model 6128 HE: 158.04 GB
Page file space	Model 6174: 95.99 GB /**95.99 GB** Model 6164 HE: 95.99 GB Model 6136: 95.99 GB /**11.99 GB** Model 6128 HE: 95.99 GB
Page file	C:\pagefile.sys

Performance test results

This section outlines the test results used by HP to characterize the optimal performance and scalability of the HP ProLiant BL465c G7 server blade. The following metrics were used:

- **Perfmon values** – Shows select Perfmon counter values for the Heavy User workload
- **Canary times** – Shows user response times for a sample canary script; used to validate optimal scalability levels

Note:
As with any laboratory benchmark, the performance metrics quoted in this performance brief are idealized. In a production environment, these metrics may be impacted by a variety of factors; for more information, refer to Appendix B – SBC solution sizing.

HP determined that there were no disk or network bottlenecks in the test environment.

The following scenarios were tested:

- Server blade configured with the AMD Opteron processor Model 6174, 6164 HE, 6136, and 6128 HE
- HP SBC test environments
  - 64-bit: 6174, 6164 HE, 6136, 6128 HE
  - 32-bit: 6174, 6136

Configured with processor Model 6174

An HP ProLiant BL465c G7 server blade featuring the AMD Opteron processor Model 6174 was tested in 64- and 32-bit HP SBC test environments.

64-bit test environment

Perfmon values and canary times are presented.

Perfmon values

HP ran a performance test using a workload based on the Heavy User profile. Figure 3 shows select Perfmon values during this test run; Figure 4 presents normalized results.

Figure 3. **% Processor Time** values – showing that 487 Heavy Users were supported when processor utilization reached 80%

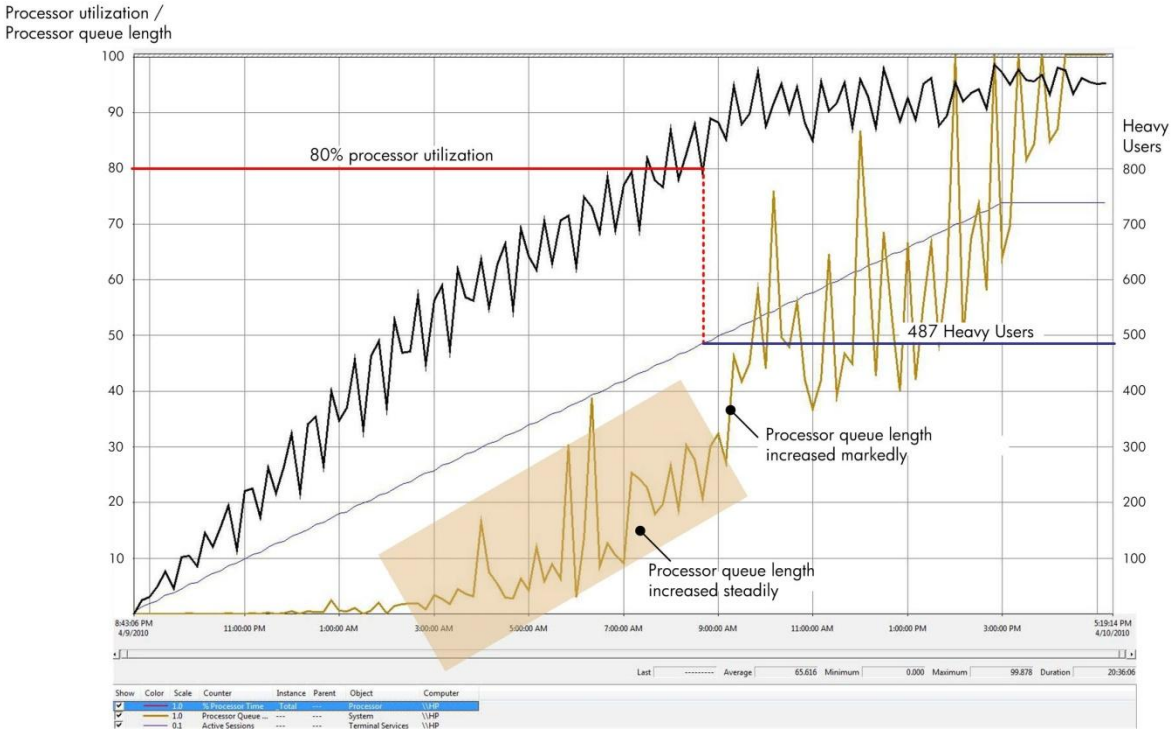
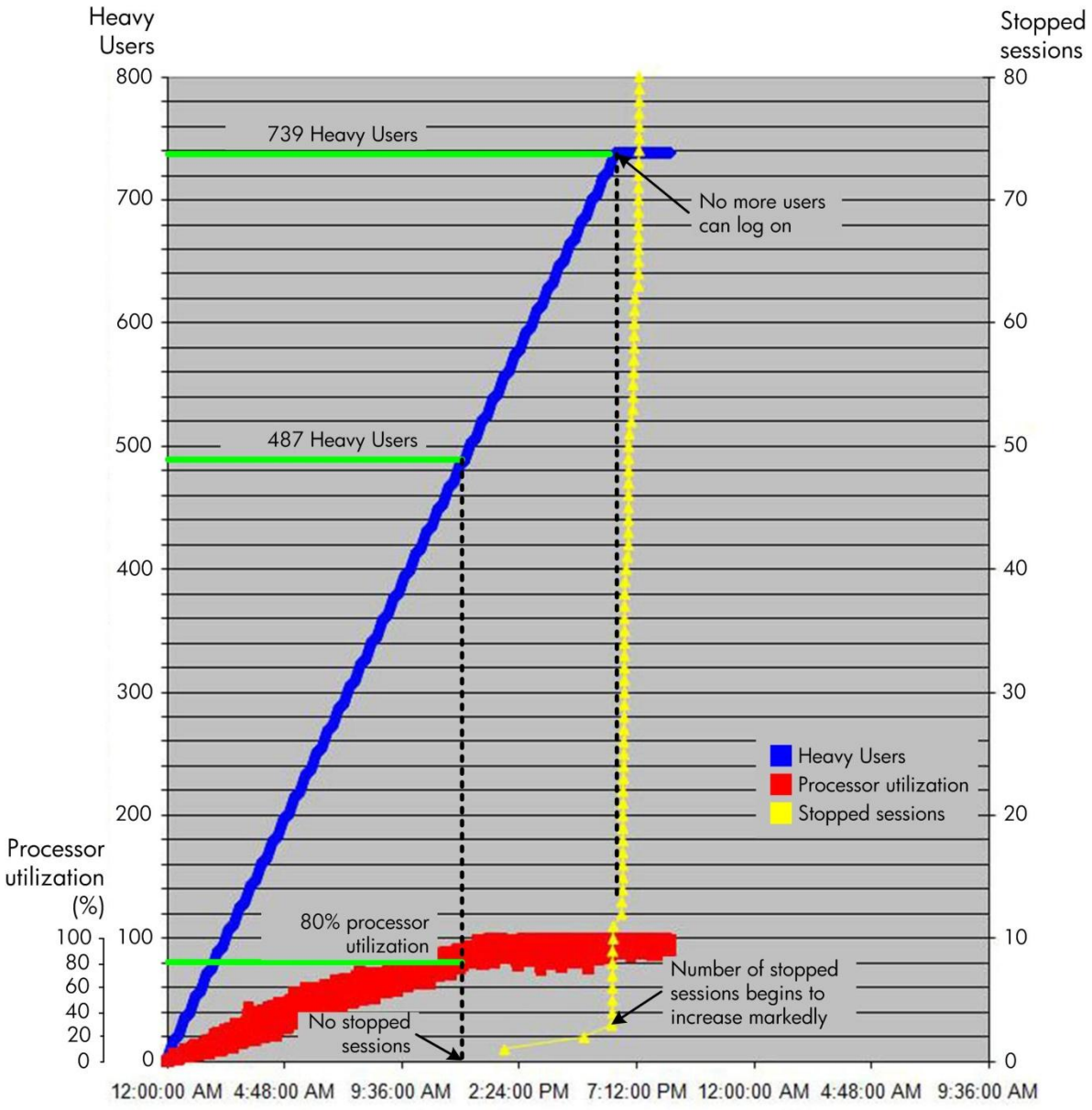


Figure 3 shows the optimal number of Heavy Users supported by the bare-metal HP ProLiant BL465c G7 server blade to be 487.

HP noted that, as the test run progressed, processor queue length started to increase steadily and never emptied. With approximately 500 users logged on (that is, more than the optimal number), there was a marked increase in queue length.

Figure 4 shows normalized Perfmon values.

Figure 4. There were no stopped sessions when 487 Heavy Users were logged on



With 487 users active, there were no stopped sessions.

The processor became saturated with approximately 500 users logged on, which coincided with the marked increase in processor queue length shown in Figure 3.

The maximum number of users able to log on was 739, though approximately 2% of sessions had stopped.

Canary times

Figure 5 shows sample results for the tested server when running a typical canary script. Individual user response times are shown in blue, with a yellow line depicting average response times.

HP analyzed this figure to determine when response times began to increase markedly and consistently over a baseline level, indicating that user response times had become unacceptable.

Figure 5. Canary time values show that user response times started to become unacceptable when 514 Heavy Users were active

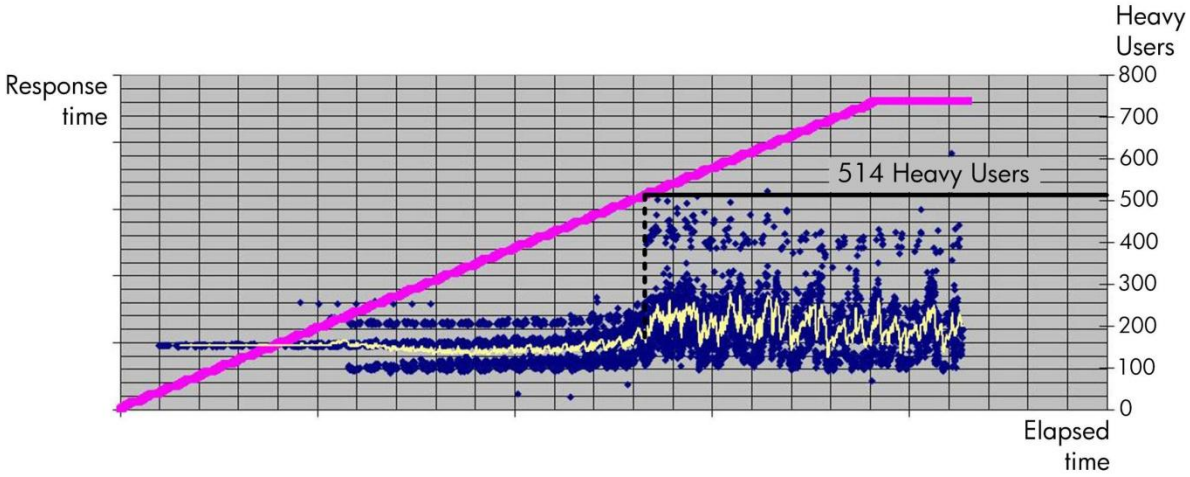


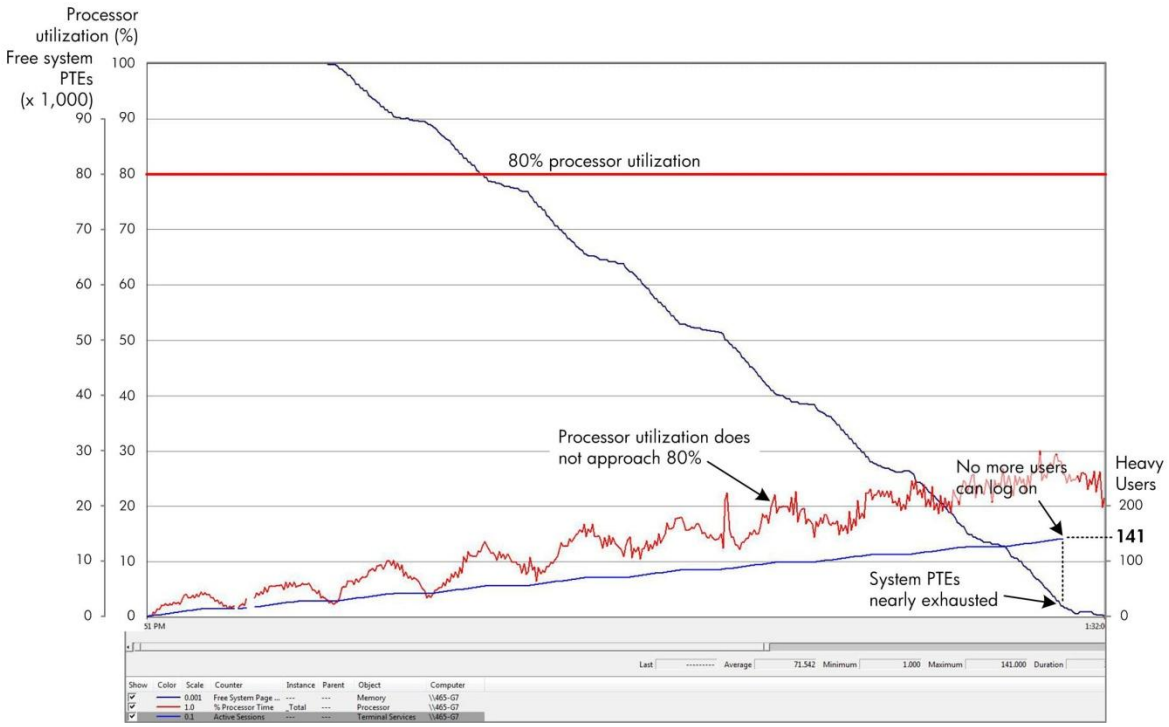
Figure 5 indicates that response times were acceptable when 487 Heavy Users – the optimal number – were active.

However, more users were able to log on up to a maximum of 739, limited by lack of CPU resources.

32-bit test environment

HP ran a performance test using a workload based on the Heavy User profile. Figure 6 shows select Perfmon values during this test run.

Figure 6. **% Processor Time** values – showing that 141 Heavy Users were supported when system PTEs became exhausted



The optimal number of Heavy Users supported by the HP ProLiant BL465c G7 server blade was 141.

Configured with processor Model 6164 HE

An HP ProLiant BL465c G7 server blade featuring the AMD Opteron processor Model 6164 HE was tested in the 64-bit HP SBC test environment.

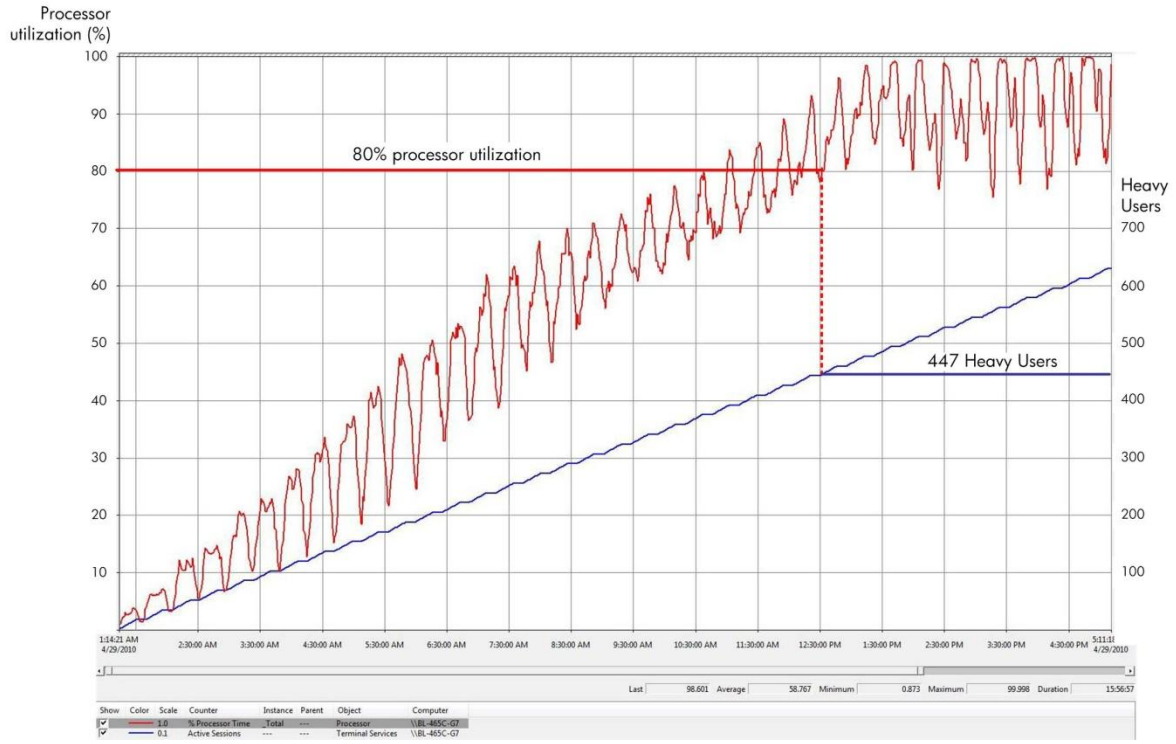
64-bit test environment

Perfmon values and canary times are presented.

Perfmon values

HP ran a performance test using a workload based on the Heavy User profile. Figure 7 shows select Perfmon values during this test run; Figure 8 presents normalized results.

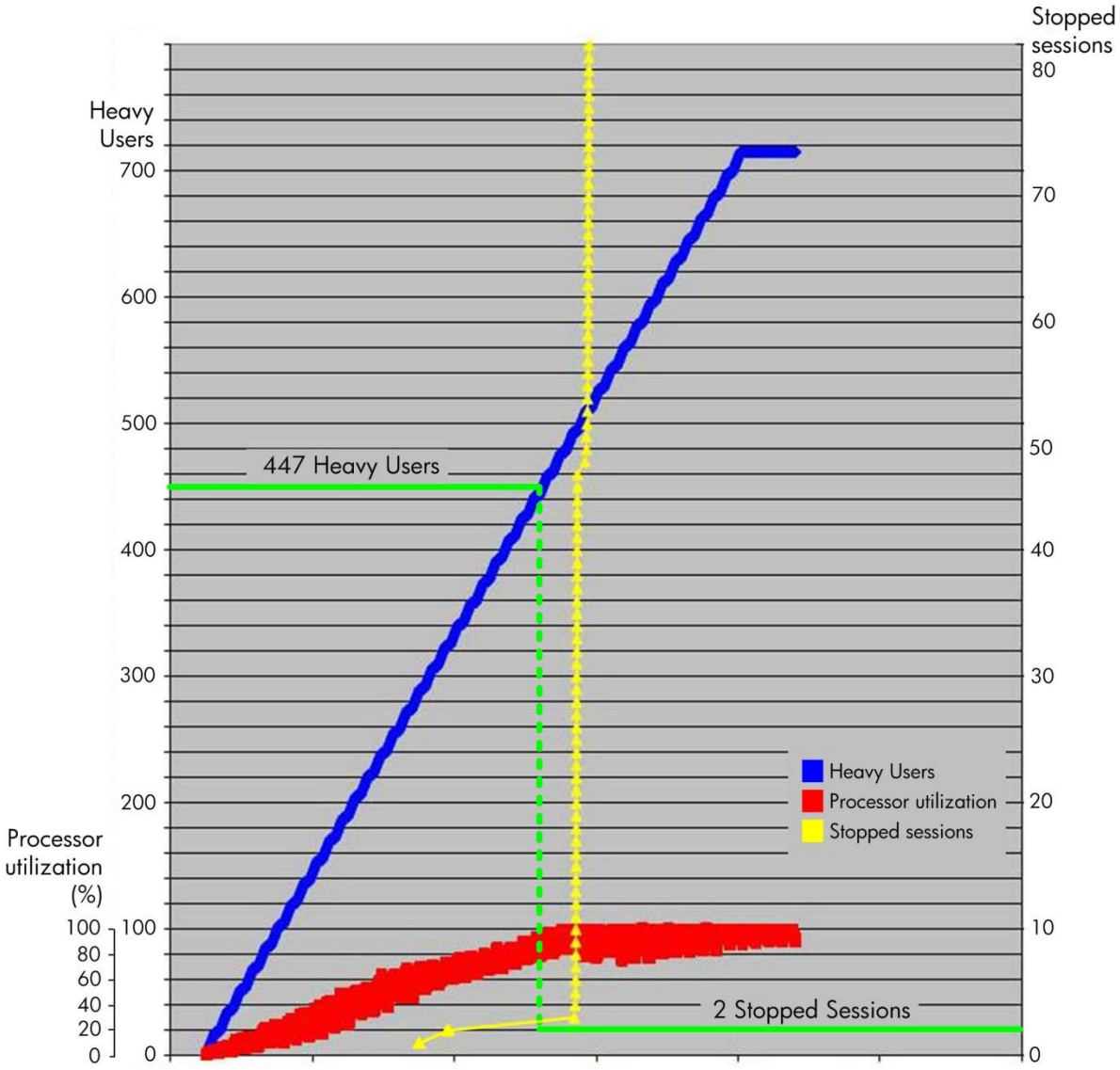
Figure 7. **% Processor Time** values – showing that 447 Heavy Users had been able to log on when processor utilization reached 80%



Thus, as many as 447 Heavy Users were supported when processor utilization reached 80%.

Figure 8 shows normalized Perfmon values.

Figure 8. Although 447 Heavy Users were able to log on, two sessions had stopped



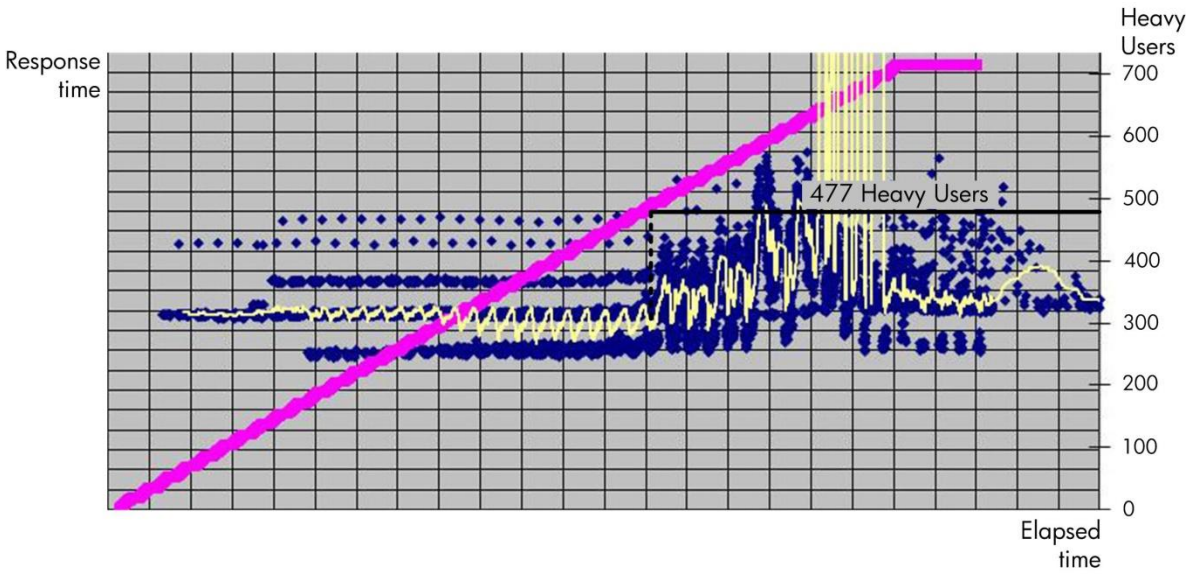
With 447 Heavy Users – the number of users logged on when processor utilization reached 80% – there were two stopped sessions. Thus the optimal number of users is (447 – 2); that is, 445.

Canary times

Figure 9 shows sample results for the tested server when running a typical canary script. Individual user response times are shown in blue, with a yellow line depicting average response times.

HP analyzed this figure to determine when response times began to increase markedly and consistently over a baseline level, indicating that user response times had become unacceptable.

Figure 9. Canary time values show that user response times started to become unacceptable when 477 Heavy Users were active



Response times were acceptable when 445 Heavy Users – the optimal number – were active.

Configured with processor Model 6136

An HP ProLiant BL465c G7 server blade featuring the AMD Opteron processor Model 6136 was tested in 64- and 32-bit HP SBC test environments.

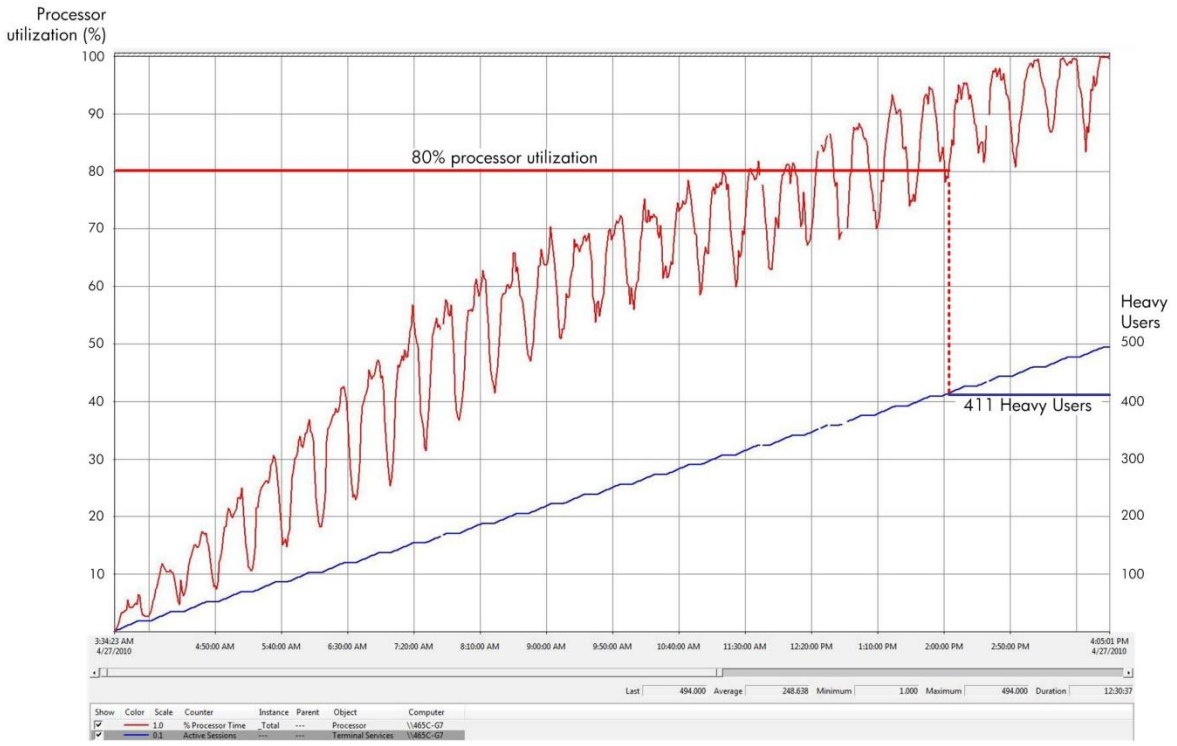
64-bit test environment

Perfmon values and canary times are presented.

Perfmon values

HP ran a performance test using a workload based on the Heavy User profile. Figure 10 shows select Perfmon values during this test run.

Figure 10. **% Processor Time** values – showing that 411 Heavy Users were supported when processor utilization reached 80%



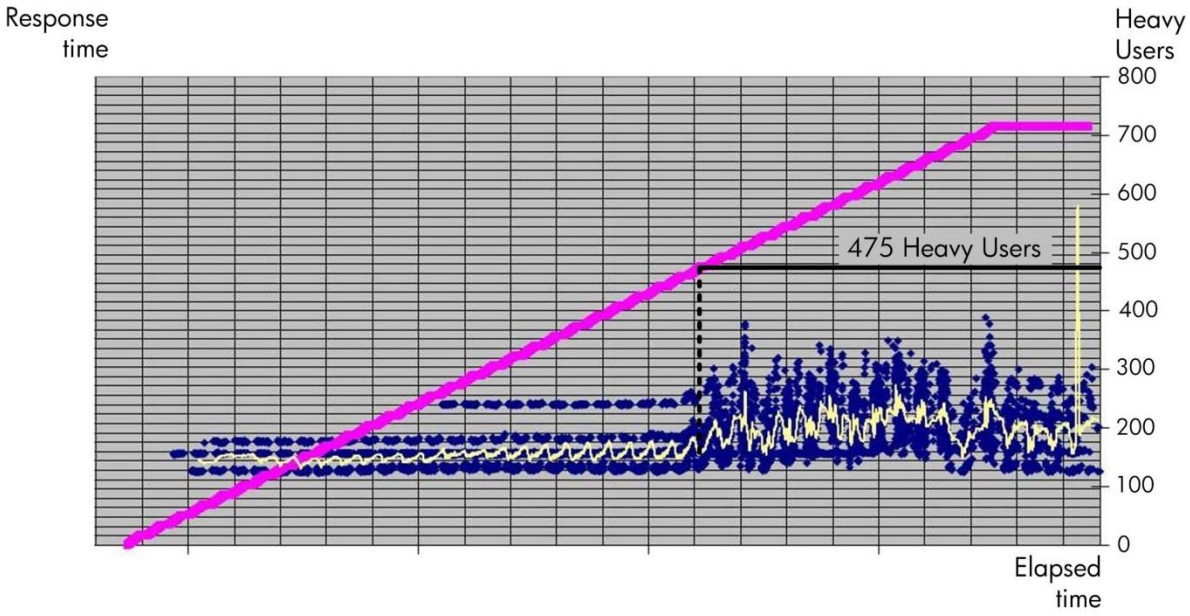
The optimal number of Heavy Users supported by the bare-metal HP ProLiant BL465c G7 server blade was 411.

Canary times

Figure 11 shows sample results for the tested server when running a typical canary script. Individual user response times are shown in blue, with a yellow line depicting average response times.

HP analyzed this figure to determine when response times began to increase markedly and consistently over a baseline level, indicating that user response times had become unacceptable.

Figure 11. Canary time values show that user response times started to become unacceptable when 475 Heavy Users were active



Response times were acceptable when 411 Heavy Users – the optimal number – were active.

32-bit test environment

HP ran a performance test using a workload based on the Heavy User profile. Figure 12 shows select Perfmon values during this test run.

Figure 12. **% Processor Time** values – showing that 161 Heavy Users were supported when disk utilization began to increase exponentially

Disk utilization increased exponentially during this test run due to lack of system PTEs.

The optimal number of users supported by this HP ProLiant BL465c G7 server blade was 161.

Configured with processor Model 6128 HE

An HP ProLiant BL465c G7 server blade featuring the AMD Opteron processor Model 6128 HE was tested in a 64-bit HP SBC test environment.

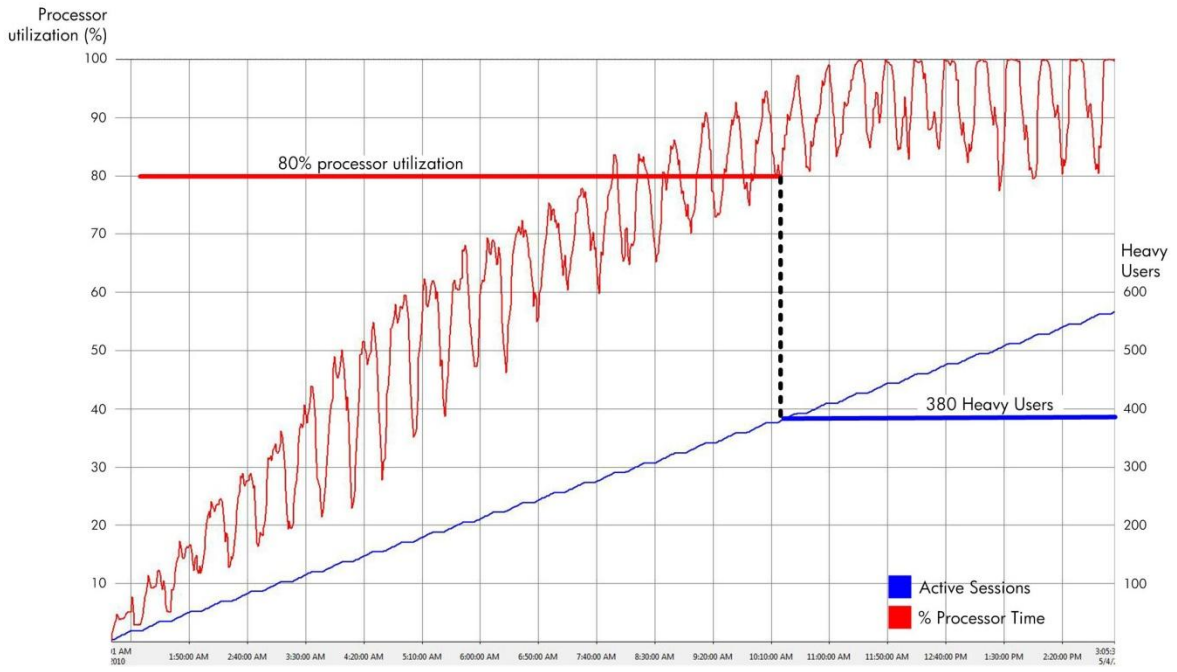
64-bit test environment

Perfmon values and canary times are presented.

Perfmon values

HP ran a performance test using a workload based on the Heavy User profile. Figure 13 shows select Perfmon values during this test run.

Figure 13. **% Processor Time** values – showing that 380 Heavy Users were supported when processor utilization reached 80%



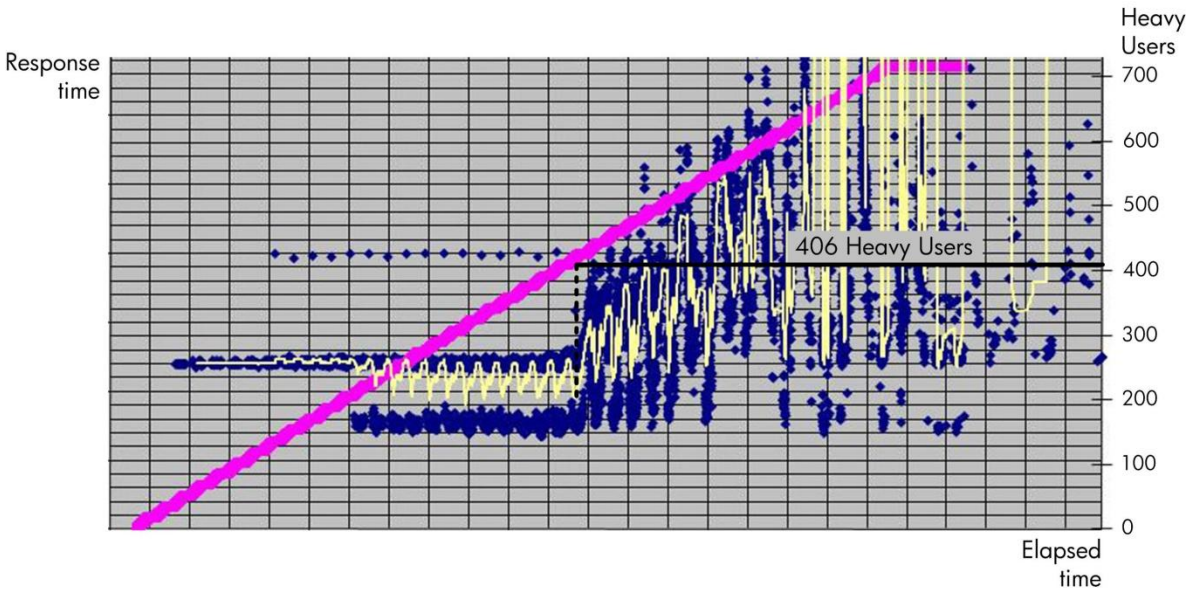
The optimal number of Heavy Users supported by the bare-metal HP ProLiant BL465c G7 server blade was 380.

Canary times

Figure 14 shows sample results for the tested server when running a typical canary script. Individual user response times are shown in blue, with a yellow line depicting average response times.

HP analyzed this figure to determine when response times began to increase markedly and consistently over a baseline level, indicating that user response times had become unacceptable.

Figure 14. Canary time values show that user response times started to become unacceptable when 406 Heavy Users were active

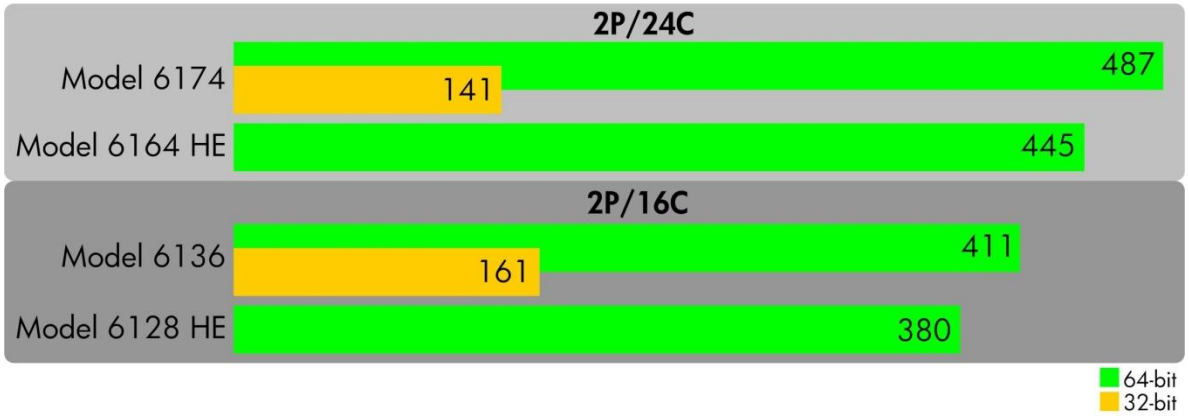


Response times were acceptable when 380 Heavy Users – the optimal number – were active.

Test analysis summary

Figure 15 summarizes the test results.

Figure 15. Optimal numbers of Heavy Users supported by the HP ProLiant BL465c G7 server blade in an HP SBC environment



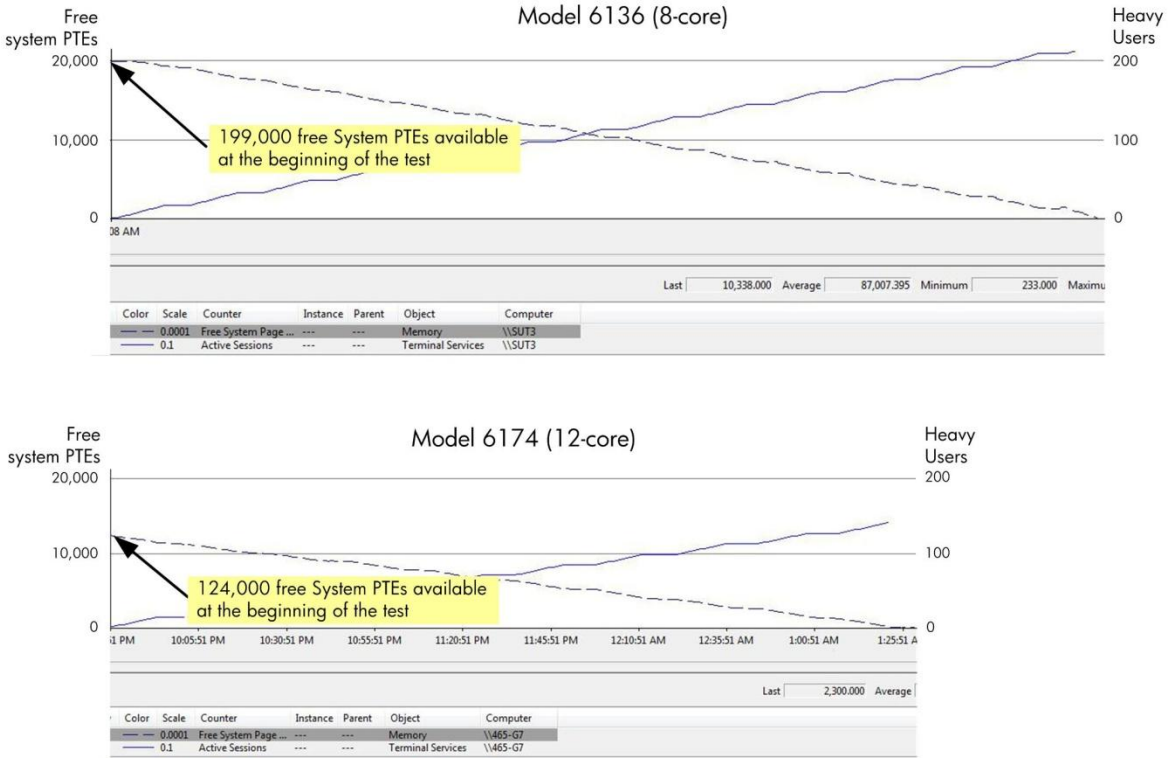
Important:
As with any laboratory benchmark, the performance metrics quoted in this performance brief are idealized. In a production environment, these metrics may be impacted by a variety of factors; for more information, refer to Appendix B – SBC solution sizing.

HP determined that there were no disk or network bottlenecks in the test environment.

Comparing scalability in the 32-bit environment

Scalability in the 32-bit HP SBC test environment was impacted by the particular processor model being used, as shown in Figure 16.

Figure 16. More users were supported when the tested server was equipped with 8-core processors



Because the amount of memory consumed by chip-set drivers increases with core density, fewer free System PTEs were available to the Model 6174 (12-core) processor-powered server at the start of the test, which translated to support for 38% fewer Heavy Users.

Recommendations

This section provides general recommendations for improving the performance of HP SBC servers.

x64 platforms

Since x64 platforms allow you to better utilize memory and multi-core processors, the bottleneck you are most likely to encounter[8] would be associated with the disk subsystem. While a detailed analysis of disk I/O performance is beyond the scope of this white paper, the following observations are offered to help you improve disk performance:

- Utilize write cache (see Using write cache)
- Since internal storage is often insufficient to support a large number of users in an HP SBC environment, consider deploying additional RAID arrays and/or SAN support. Note also that when a SCSI RAID array is used to host user profiles and page files, the number of spindles deployed has a significant impact on the response times associated with file access.

  When the pressure on the disk I/O subsystem is high, one option for improving disk access times is to add RAM to lower the pressure on memory.

  As the number of sessions increases, disk activity and the pressure on the disk I/O subsystem also increase. If file I/O activity is high, the probability that requests will find the desired data in memory decreases, thus negatively affecting file access times.

Avoiding disk I/O bottlenecks

To help you avoid disk I/O bottlenecks, Microsoft recommends using the Windows performance monitoring tool, Perfmon, to check the following metrics[9]:

- **%Idle time** – Idle times for logical and physical drives should average at least 50%
- **Average Disk Seconds/Read** and **Average Disk Seconds/Write** – The average time taken to complete a read or write should average less than 25 milliseconds, with peaks less than 50 milliseconds

If the above conditions specified by Microsoft cannot be met, a disk I/O bottleneck is likely.

Note:
In the event of an I/O bottleneck, you should tune the disk subsystem, decrease the number of users or applications, or add memory to the server.

Using write cache

HP Smart Array controllers include an allocation of memory that can be utilized to temporarily cache data being written to or read from disk. Since access to this memory is significantly faster than disk access, cache can enhance overall server performance, particularly during login operations.

Write cache is of particular interest in an HP SBC environment. After buffering all the data associated with a particular write command, the Smart Array controller indicates to the HP SBC server that the data transfer to the disk is complete – even through the data is still being written to disk. This frees up the server's processor to perform other tasks and accelerates data throughput.

[8] For further information, refer to the HP white paper, "Scalability and performance of HP ProLiant servers on 64-bit Microsoft Windows Server 2003 in an HP SBC environment."
[9] For further information, visit the Microsoft website.

Note:
HP has not yet characterized FBWC performance in the HP SBC environment. However, testing performed using BBWC demonstrates that, typically, improvements from write cache are most significant when the HP SBC server is performing log-intensive operations and/or when significant page file write operations are necessary, such as during user logins. Performance gains ranged from 50% to 250%[10]; actual results would vary depending on the application(s) involved and your particular HP SBC environment.

FBWC is enabled by default. Use the BIOS to set the read/write ratio[11].

Virtualization

To take best advantage of the benefits delivered by virtualization, you need to understand your HP SBC environment. In addition, be aware that virtual machine (VM) performance may vary depending on the application, the guest operating system, and other factors; you should test the VM prior to implementation in a production environment. Also be aware that some applications are good candidates for virtualization, others less so: for example, underutilized HP SBC servers, servers running infrastructure services, and Citrix XenApp data store servers may be good candidates for virtualization; HP SBC servers running resource-intensive applications and highly-utilized infrastructure servers may not be such good candidates.

When you are planning a virtualized implementation, ensure you have selected a server with the CPU capacity and number of cores you need. Make sure you meet the resource requirements for virtualization overhead, guest operating systems, and applications. Would a storage array network (SAN) be a better choice than internal storage? Are there enough network interface cards (NICs)?

To correctly size the HP SBC servers you intend to virtualize, you must understand the associated applications and the numbers of users and user profiles to be supported. You should balance the number of VMs deployed on a particular server with the number of vCPUs allocated to each VM; you should also allocate enough RAM to eliminate memory and I/O bottlenecks. Prior to deployment, HP recommends testing your VMs in a production test environment with live users.

In addition to suitable sizing, optimal VM performance requires Citrix XenServer and guest operating systems to be appropriately configured. For example, consider disabling the screen saver associated with the XenServer VM controller window.

To avoid spikes in processor utilization, ensure your VMs are online before applying the workload. Do not simultaneously add large numbers of users; if possible, balance the workload across your VMs.

A broad range of tools is available to help you manage a virtualized HP SBC environment, including Citrix Essentials for XenServer Solution - HP Edition and Citrix XenCenter.

VMs are flexible, allowing you to readily implement the level of availability you need. Moreover, you can enhance availability by utilizing a storage array network (SAN) created from HP StorageWorks product offerings. Capabilities may include:

- Multiple paths for redundancy
- Automatic path failover
- High-availability cluster support

[10] For further information, visit the HP website.
[11] For most applications, HP recommends 100% write.

Note:
For more information on best practices associated with virtualization, refer to the HP white paper, "Best practices for deploying Citrix XenApp on XenServer."

Conclusions

When planning an x64 HP SBC environment, you should select servers equipped with multi-core processors to help maximize scalability. If your budget allows, consider the fastest processors, the most cores, and largest cache; if your objective is to reduce overall power consumption and you are prepared to accept a small performance penalty, use low-power processors.

Memory is an important factor in the x64 environment: while an x64 platform can utilize more RAM, it also has a higher minimum RAM requirement than an x86 platform. Since a system that is not memory-starved is less likely to experience disk I/O bottlenecks, HP recommends adding as much RAM as your budget permits.

For optimal performance, configure FBWC for 100% write. Consider using 15,000 rpm SAS drives.

Virtualized server

Do not oversubscribe vCPUs – after a certain point, additional vCPUs can degrade performance. Determine the optimal server configuration for your particular workload: How many VMs? How many vCPUs? How much memory? Significant testing may be required.

Consider virtualizing later x86 platforms to take advantage of improvements made to processors, memory, and I/O. You may experience dramatic scalability enhancements.

Appendix A – Using Microsoft Windows Server 2003 x64 Editions

Microsoft offers operating systems that support both 64- and 32-bit applications, as well as existing 32-bit deployment and management tools – all on the same platform. These operating systems provide an evolutionary path to 64-bit technology, allowing 64- and 32-bit applications to run side-by-side during the gradual migration to 64-bit computing.

64-bit editions of Windows Server 2003 running on today's multi-core AMD Opteron or Intel Xeon processors can improve the performance of HP SBC servers by processing more data per clock cycle, addressing more memory, and running some numerical calculations faster. Large data sets can be loaded entirely into memory, reducing the need for slower disk access; complex calculations that take hours to complete on a 32-bit system can be performed in minutes; and workloads that once required a large server farm can be performed by a single server.

In addition, 64-bit platforms also remove many of the limitations that have previously inhibited scalability in an HP SBC environment.

Historical scalability limitations

32-bit Windows operating systems can directly address 4 GB of memory, 2 GB of which is reserved for the operating system kernel and 2 GB for applications. Since kernel memory is shared by all applications, the relatively small size of this space can be particularly problematic in an HP SBC environment where a server may be responsible for hundreds of users and thousands of processes. In this scenario, kernel memory can become constrained, making user response times unacceptably long and effectively limiting the ability of the server to scale up.

Historically, HP SBC environments have been implemented using 1P or 2P servers. Larger, more powerful servers have typically not been deployed for two main reasons:

- Kernel memory issues have limited the performance of more powerful servers; either a disk I/O bottleneck occurs or kernel memory is consumed before processor resources can be fully utilized
- Scalability in a 32-bit symmetric multi-processing (SMP) system is inherently non-linear above 2P

With these 1P and 2P server farms, opportunities to scale up are limited. As a result, customers are forced to scale out, which can create new problems such as deployment and management complexity, high power and cooling requirements, under-utilized resources, and minimal opportunities for server consolidation.

The 64-bit platform shatters the earlier 4 GB limitation – for example, Windows Server 2003 R2 Datacenter x64 Edition with Service Pack (SP) 1 supports up to 2 TB of RAM – effectively removing kernel memory limitations and eliminating disk I/O bottlenecks. By deploying a Windows Server x64 Edition operating system, customers can fully utilize the resources of their existing HP SBC servers and take full advantage of new, more powerful systems – whether they are running 32- or 64-bit applications.

More information

For more information on the impact of 64-bit Windows Server 2003 x64 Editions in an HP SBC environment, refer to the HP white paper, "Scalability and performance of HP ProLiant servers on 64-bit Microsoft Windows Server 2003 in an HP SBC environment."

To learn about 64-bit computing in an HP SBC environment, refer to the HP white paper, "Fundamentals of 64-bit computing in an HP SBC environment."

Appendix B – SBC solution sizing

As with any laboratory benchmark, the performance metrics quoted in this performance brief are idealized. In a production environment, these metrics may be impacted by a variety of factors, including the following:

- **Overhead**
  Agents and services (virus scanning, backup and restore, provisioning, security, management and more) automatically consume overhead. Rogue applications can consume additional overhead. The system architect may wish to provide a 25% – 30% buffer to accommodate this overhead.
- **Future growth**
  To accommodate future growth, the system architect may wish to provide an additional buffer. Alternatively, servers can be added as needed, taking advantage of the server farm's inherent ability to scale out.
- **User profiles**
  The particular application in use directly impacts the number of users supported by a particular server. Further, user behavior can also impact scalability:
  - Increased typing rates correspond to fewer users.
  - Opening and closing applications (rather than switching between them) or moving quickly between tasks can place a heavier load on the server.
  - Sizing for this performance test was based on the Heavy User profile described in User profile. If this profile does not match your needs, more profiles are available using the online sizer tool (described below); alternatively, the system architect can consult HP Services for more information.
- **Background grammar checking**
  Background grammar checking can significantly impact scalability, reducing the number of users supported by as much as 50%. HP disabled background grammar checking for the testing described in this performance brief.

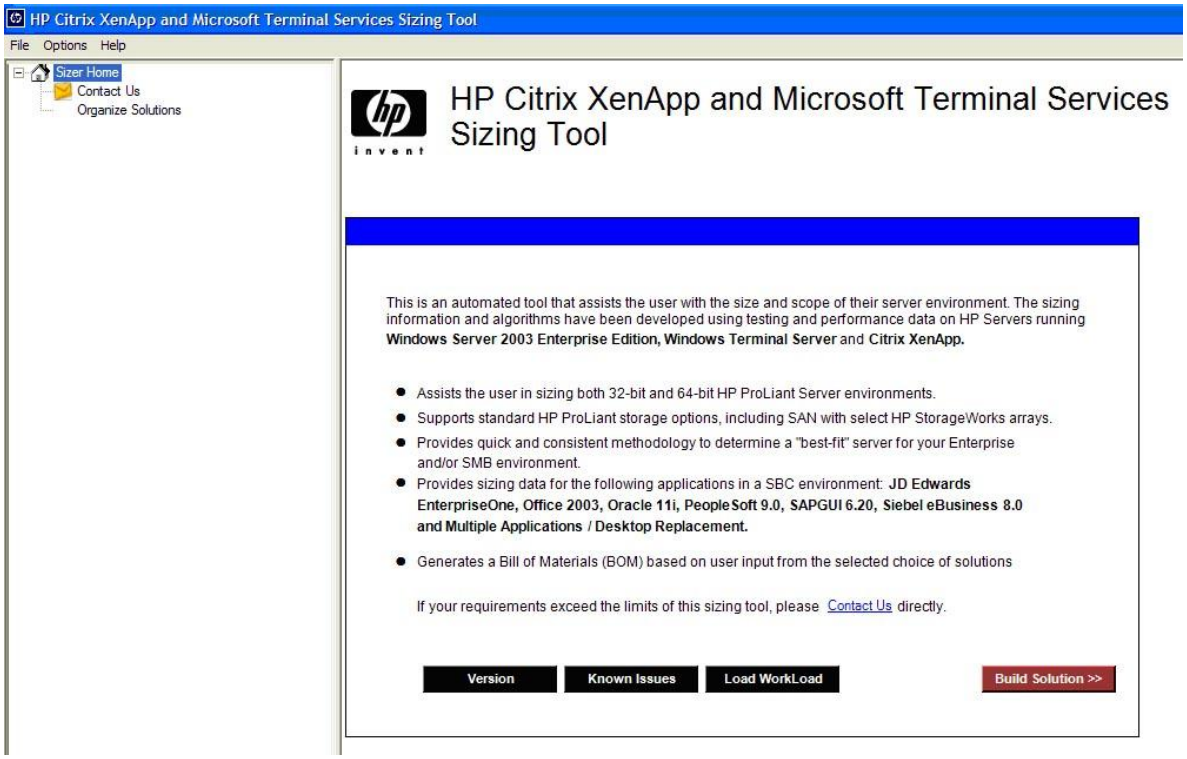
Online sizer tool

To minimize risk, HP offers automated, downloadable tools that can help you size an HP SBC solution. A sizer (HP ProLiant Sizer for Citrix XenApp and Microsoft Windows Server 2003 Terminal Services) is available for enterprise and small and medium business (SMB) environments.

The algorithms and methodology used by this sizer are based on the results of customer surveys and thorough testing.

Figure B-1 shows the home page for the sizer.

Figure B-1. Home page for the HP Citrix XenApp and Microsoft Terminal Services Sizing Tool



Based on information provided by the customer, the sizer can provide a quick, consistent mechanism for identifying the "best-fit" server for a particular HP SBC environment and generate a Bill of Materials (BOM) for that server.

For more information

HP ProLiant BL465c G7 server blade	http://www.hp.com/servers/bl465c
HP ActiveAnswers solution area for HP SBC, including Citrix XenApp and Microsoft Terminal Services	http://www.hp.com/solutions/activeanswers/hpsbc
HP ProLiant Sizer for Citrix XenApp and Microsoft Windows Server 2003 Terminal Services	http://h71019.www7.hp.com/ActiveAnswers/cache/70245-0-0-0-121.html
HP Services	http://www.hp.com/hps/
HP Solution Centers	http://www.hp.com/go/solutioncenters
Citrix XenApp	http://www.citrix.com/site/PS/products/feature.asp?familyID=19&productID=186&featureID=4110
Citrix XenServer	http://h71019.www7.hp.com/ActiveAnswers/cache/457122-0-0-225-121.html http://www.citrix.com/English/ps2/products/product.asp?contentID=683148
Citrix Essentials for XenServer Solution - HP Edition	http://h18004.www1.hp.com/products/servers/software/citrix/

To help us improve our documents, please provide feedback at http://h20219.www2.hp.com/ActiveAnswers/us/en/solutions/technical_tools_feedback.html.

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